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March 1972

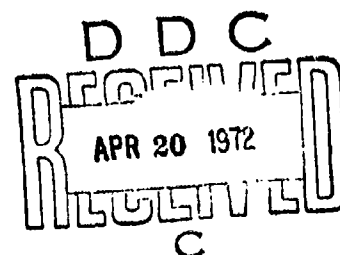
NATURAL DISASTER OPERATIONS PLANNING

Prepared for:

OFFICE OF CIVIL DEFENSE
OFFICE OF THE SECRETARY OF THE ARMY
WASHINGTON, D.C. 20310

CONTRACT DAHC20-71-C-0287
OCD Work Unit 2612A

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Concept of operations						
Alert						
Destructive impact situations						
Paralyzing situations						
Earthquake						
Flood						
Hurricane						
Tornado						
Hazardous materials						
Explosion						
Fire						
Tsunami						
Radioactive fallout						
Winter storm						
Mutual aid						
Operating zone						
Emergency organization						
NADOP checklist						
Evacuation						
Remedial movement						
Fire fighting						
Search and rescue						
Countermeasures						
Civil defense						

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Detachable Summary

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DETACHABLE SUMMARY

This research was concerned with the development of a general concept of emergency operations and a prototype NADOP (natural disaster operations plan). The research focuses on local operations during an emergency that begins with recognition of a threatening situation, includes the impact or onset of a disaster agent, and continues until ensuing hazards no longer present a substantial threat to a community.

This concept of operations is based on classifying the several potential disaster agents (flood, fire, earthquake, tornado, hurricane, explosion, transportation accident, winter storm, and so forth) into two types: (1) disaster agents with destructive impact and (2) disaster agents with a paralyzing effect. Nine BOS (basic operating situations) are then derived. Each BOS is defined according to the severity (negligible, moderate, extreme) of the threats posed by each type of disaster agent, either singly or in combination. The BOS in turn provide the basis for developing a set of contingency plans that are responsive to the dynamics of an emergency. These contingency plans are in the form of a dynamic checklist of emergency actions keyed to triggering events. The checklist is published separately, but is summarized in this report. The table on the next page summarizes the concept of operations for each contingency.

SUMMARY OF CONCEPT

<u>Contingency</u>	<u>Highest BOS Numbers</u>	<u>Theme of Emergency Operations</u>
A - Alert	BOS-1, 2, or 3	Increase readiness and protection*
B - Distant impact	BOS-1, 2, or 3	Backup support*
C - Close but clear	BOS-1, 2, or 3	Close support*
D - Damage	BOS-4, 5, or 6	Control damage, fire, and flooding; conduct search, rescue, and first aid*
E - Untenable	BOS-7, 8, or 9	Evacuate untenable areas*
F ₁ - Moderate hazards	BOS-2, 5, or 8	Limit exposure to environmental hazards†
F ₂ - Extreme hazards	BOS-3, 6, or 9	Prohibit nonessential operations†

* Limiting exposure to environmental hazards as feasible if Contingency F exists concurrently.

† Unless an untenable situation exists or is imminent (Condition Black).



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ACKNOWLEDGMENTS

This study is one of a series of studies sponsored by the Office of Civil Defense under the broad classification of Emergency Operations Research (OCD research task area 2610). These studies have the common objective of evaluating the feasibility and potential benefits of contingency planning for civil defense operations. This study was concerned with the application of contingency planning principles to natural disasters.

The successful conduct of this study is mainly due to the interest, technical supervision, suggestions, and contributions of Mr. Walmer E. Strobe, Assistant Director of Civil Defense (Research); Mr. James Kerr, Staff Director for Support Systems Research; and Mr. George Van den Berghe, the contracting officers' technical representative.

The project was centered in the Operations Evaluation Department of Stanford Research Institute and conducted under the general supervision of Mr. Richard Bothun, Program Manager. Charles T. Rainey was the principal investigator. Miss Betty Neitzel, Operations Analyst of the Engineering Systems Division staff, made major contributions to the development of a prototype checklist of natural disaster operations. Mr. Tom Logothetti assisted in the analysis of countermeasure actions for various disaster agents. Mr. William White helped define the concept of operations.

Mr. Jack Richardson, field representative of the System Development Corporation, prepared scenarios of actual disaster situations, based on an examination of operations logs and other records of communities that have experienced hurricanes, tornadoes, and other natural disasters. This work was accomplished by means of a subcontract to SDC.

I INTRODUCTION

Background

During the past several years, the Office of Civil Defense has sponsored a series of studies concerned with nuclear emergency operations planning. These studies have led to the development of a dynamic NEOP (nuclear emergency operations plan) that identifies the actions that would be appropriate under the spectrum of situations that might exist in an operating zone.^{1*} The techniques used to develop the NEOP consist of the partitioning of an emergency into a set of basic operating situations representing differing types or levels of hazard, and preparing a master check list of action for each situation. Key events are defined that control the transition from one basic operating situation to another.

Most state and local civil defense organizations are concerned with planning for natural disasters as well as for nuclear emergencies. Though there are substantial differences between these two types of emergencies, the planning problems that they pose are similar and many of the actions that would be appropriate during a nuclear emergency are also appropriate during natural disasters. This study was therefore initiated to develop a prototype NADOP (natural disaster operation plan) that is generally compatible with the NEOP.

* References are listed following the main body of this report. A superscript numeral identifies the specific reference.

Scope

The research included the following tasks:

- (1) Based on a review of past natural disaster operations, develop a general concept of operations for natural disasters equivalent to and patterned after the "Concept of Operations Under Nuclear Attack,"² including a suitable matrix of basic operating situations.
- (2) Devise a prototype master checklist based on the natural disaster concept of operations and in the format of the working draft FG G-1.2/2³ making the minimum changes required to fit the natural disaster concept.
- (3) Demonstrate how a checklist for a particular type of disaster, such as tornado, flood, or hurricane, can be derived from the master checklist.
- (4) Test the master checklist against a variety of actual disaster scenarios to establish that the planned actions are complete and appropriate.

Method of Approach

The research centers on emergency operations by and within a local jurisdiction, but also considers interjurisdictional operations to either obtain support from or provide support to other jurisdictions. In the context of this study, an emergency is a situation in which the safety of people and property are threatened and in which the normal ways of doing things will not work. Therefore, those situations that can be handled by the departments and agencies of governments through their normal administrative and operational procedures were not considered in this research.

Initially, a provisional matrix of BOS (basic operating situations) was postulated that was analogous to the BOS previously defined for a nuclear emergency. This provisional BOS matrix compared quantitative changes in the threat posed by the impact of a disaster agent with a continuum of hazards due to environmental conditions. This provisional

BOS matrix was then used as a framework for reviewing and analyzing information on past natural disasters. The chief sources of information were the publications of the Disaster Research Center of Ohio State University. 8-14

During the course of the review, it became evident that more detailed information regarding the dynamics of an emergency situation would be required. Therefore, arrangements were made through the California State Office of Emergency Services to review the operations logs of selected jurisdictions in California that have experienced natural disasters. Arrangements were also made with the System Development Corporation for their field representatives to examine operations logs of communities that have experienced hurricanes, tornadoes, winter storms, and other disasters that occur infrequently in California. This work was accomplished under subcontract number 13,547 and included the development of a set of actual disaster scenarios to be used for testing the master checklist. An appendix to this report lists the natural disasters that were reviewed and the scenarios that were developed during the course of this study.

A general concept of operations was then derived (see Task 1 under Scope above). This concept is generally analogous to the "Concept of Operations Under Nuclear Attack" but focuses on natural disaster agents. Chapter II of this report presents this general concept of operations and describes how the concept can be used to plan the countermeasure actions appropriate for hurricanes, tornadoes, floods, or other particular disaster agents (Task 3).

The prototype master checklist of emergency actions for natural disasters, called for in Task 2, has been submitted separately. Its major provisions are described in Chapter III of this report. The event/action structure of the master checklist was compared with actual disaster scenarios described above (Task 4 of Scope) and found to be generally responsive to the situations described in the scenarios.

II A GENERAL CONCEPT OF EMERGENCY OPERATIONS

Emergency Operations Plans

Every year many American communities are threatened by situations that call for emergency actions to prevent disastrous loss of life and property. Since 1953, the President has made more than 250 major disaster declarations because of need for federal financial assistance to disaster relief and recovery operations. In addition to those major declared disasters, there have been many more disasters of lesser magnitude, and many communities have experienced emergency situations in which the threat posed by the situation has not materialized or the threat has been averted by countermeasure actions.

Potentially disastrous emergency situations may be caused by a number of disaster agents. Some disaster agents, such as floods, hurricanes, tornadoes, earthquakes, winter storms, and so forth, are the result of natural phenomena. Others, such as explosions, fires, transportation accidents, and the release of hazardous materials or pollutants may be described as man made and are generally the result of accidents. Finally, an enemy attack involving nuclear weapons must be considered as a possible, however unlikely, disaster agent.

Many local governments have an emergency operations plan that provides for warning the people of threatening situations, defines how the community's resources will be mobilized and organized during an emergency, and assigns responsibility for performance of emergency functions to elements of an emergency organization. Comparable plans to support local emergency operations, to care for affected people, and to assist in the recovery of affected communities have been developed by state and federal agencies and

by supporting nongovernmental organizations. However, few, if any, of the plans that have been developed contain a detailed plan of action for all of the potentially disastrous situations that might affect the community.

The potential value of an emergency operations plan is difficult to measure because: (1) the threats posed by a situation do not always materialize; (2) emergency actions, even though unplanned, may be appropriate and effective in many situations; (3) in some cases, even though there is a plan, coping with the threat(s) is beyond the capability of the effected community and disastrous loss of life or property is experienced; and, (4) following an emergency, it is difficult to attribute a specific savings of lives or property to the existence of a plan. Emergency operations logs, after action reports, and other records prepared by governmental units that have participated in disaster operations give an insight into actions that are required during an emergency. However, they are of limited value in assessing the effectiveness of their plan.

The report of the Sutter County Grand Jury on the tragic experience of Yuba City, California, during the disastrous floods of Christmas week 1955,⁴ provides perhaps the most dramatic argument for and indicates the potential value of planning for emergencies that are likely to affect a community. The Grand Jury found that, had the responsible local authorities fully utilized the information available to them during the emergency, the loss of life would have been greatly minimized and perhaps completely avoided. Instead, 39 lives were lost due to inaction and inappropriate action on the part of responsible officials. Had there been an emergency operations plan to guide the actions of the local officials during the developing flood emergency, it is likely, but not certain, that actions would have been taken in time to evacuate the area that was known to be threatened by an imminent levee break, and loss of life might

have been avoided. Following the Grand Jury hearings, those officials who failed to perform their duties were removed from office.

Purpose and Scope

The general concept of emergency operations presented below is intended as a framework for planning emergency operations and for training during the preemergency period.

The desirability of a general concept of emergency operations, which can be used as a common framework for developing coherent emergency operations plans, has been recognized by federal, state, and local civil defense organizations for some time. A commonly understood concept of operations is essential if organizational elements from different jurisdictions and areas are to function in a cooperative and effective way under emergency conditions. This is also true for smooth functioning of military support to civil authorities and for obtaining support from nongovernmental organizations. An accepted concept of operations is also a prerequisite to training for emergency operations. Moreover, as the concept of operations becomes accepted and standardized, the experience gained in an emergency can more readily be carried over and applied to subsequent emergencies, though they may be due to different causes.

The concept of operations is intended to apply to all potential emergency situations whether due to natural causes or accidents and can be extended to a threatened or actual attack on the United States. However, the concept does not apply to control of civil disturbance or other social or economic conditions that may give rise to an emergency situation.

An "emergency," in the context of this concept, is a situation in which lives and property are threatened and that cannot be handled by the departments and agencies of government through their normal administrative

and operational procedures. This excludes day to day situations for which the government is prepared.

The "emergency period" considered in this concept begins with recognition of an existing or developing situation that poses a potential threat to a community, includes the warning and impact phase, and continues until the immediate and ensuing effects of the disaster agent no longer constitute a substantial hazard. The concept does not consider problems of managing recovery operations that may be required following the emergency period when normal administrative procedures may be resumed.

"Emergency operations" comprise all actions that are taken during the emergency period to protect life and property, to care for affected people, and to maintain or restore essential community services. The general objectives of the operations described in the concept of emergency operations are:

- To improve the capability and increase the readiness of a local government to respond to potential emergency situations.
- To minimize, to the extent feasible, loss of life and property in the event that a jurisdiction suffers direct or residual effects of a disaster agent.
- In the event that a jurisdiction is not seriously affected, to provide for the efficient use of the local governments resources and emergency forces in support of emergency operations in more seriously affected jurisdictions.
- To provide for the immediate needs of people adversely affected by the disaster agent.
- To provide a basis for restoration of essential community services and facilities.

This concept focuses on localized emergency operations within a local jurisdiction, or a group of contiguous jurisdictions, that is threatened by or experiences an emergency situation. The requirement for

interjurisdictional mutual aid and support from outside the affected area is also provided for in the concept. The concept does not address emergency operations that entail moving large number of people over long distances during a period of forewarning and providing for their protection and care in jurisdictions distant from the threatened area. In certain emergency situations, notably during periods when a hurricane poses an imminent threat to coastal communities, evacuation of threatened areas and movement of the people to safer areas would be appropriate. It is considered that control of such large scale evacuation would be the function of the state rather than local government.

Dimensions of an Emergency

An emergency may be caused by a single disaster agent or by a combination of disaster agents. Often, as indicated by Figure 1, the impact of one disaster agent may give rise to another. There are specific countermeasures required to cope with the threat posed by each disaster agent. The severity of the threat may vary considerably with time and from place to place in the affected area. In some cases, emergency operations may be confined to a single jurisdiction. In other cases, the emergency conditions may be beyond the capability of the jurisdiction or may extend beyond its boundaries and interjurisdictional emergency operations may be required.

Emergency operations must be conducted under a wide variety of local conditions. Some communities are more susceptible than others to a given threat. The availability of resources varies greatly from community to community. Organizational relationships within a local government, among local governments, and between local and state governments, are often complex and distinctive. Emergency operations plans must recognize those local conditions and, as a result, considerable variation in the manner in which emergency forces are organized and employed during emergencies is to be expected in different communities.

MAJOR EVENT	POSSIBLE ENSUING EVENTS											
	FLASH FLOOD	SLOW RISE FLOOD	STORMTIDE	THUNDERSTORM	TORNADO	TORRENTIAL RAINS	TSUNAMI	LANDSLIDE, DAM OR LEVEE BREAK	TRANSPORTATION ACCIDENT	FIRE	EXPLOSION	HAZARDOUS MATERIAL
HURRICANE			●	●	●	●			●	●	●	●
FLOOD								●	●			
THUNDERSTORM					●	●				●	●	
TORNADO				●		●			●	●	●	●
TORRENTIAL RAINS	●	●						●	●			
WINTER STORM		●						●	●			
EARTHQUAKE							●	●		●	●	●
TSUNAMI	●							●				●
LANDSLIDE, DAM OR LEVEE BREAK	●	●							●			
TRANSPORTATION ACCIDENT										●	●	●
FIRE											●	●
EXPLOSION										●		●
HAZARDOUS MATERIAL										●	●	

Figure 1 COMPOUND THREAT SITUATIONS

Nevertheless, the basic principles of protection against each type of disaster agent are generally the same, regardless of location, and may be used as the basis for operations planning and training.

Various models of disaster events have been proposed and employed in disaster research studies. The disaster model that appears to be most relevant to the problems of emergency operations planning was developed by Russell R. Dynes of the Disaster Research Center of Ohio State University. He identifies nine characteristics of disaster agents that have implications for the types of community tasks that are created and are relevant to the ability of the community to handle them. According to Dynes, the causes of a disaster--known as disaster agents--differ as to their: frequency, predictability, controllability, cause, speed of onset, length of possible forewarning, duration, scope of impact, and destructive potential.⁵

Contingency Situations

As a basis for defining the emergency situations that may occur in a community, it is necessary to classify the several disaster agents according to their effects and the countermeasures that are appropriate to cope with those effects. As shown in Table 1, disaster agents may be

Table 1

CLASSIFICATION OF DISASTER AGENTS

<u>Destructive Impact</u>		<u>Paralyzing Effect</u>	
Collision	Hurricane winds	Radioactive fallout	Torrential rains
Earthquake	Landslide	Release of hazardous	Wind storm
Explosion	Storm tide	materials	Winter storm
Fire	Tornado	Slow rise flood	
Flash Flood	Tsunami	Thunderstorm	

classified as having either a destructive impact or a paralyzing effect. Some disaster agents present both types of threats. Since more than one disaster agent may be present during an emergency, and since the affected area is limited, four types of emergency situations may be identified:

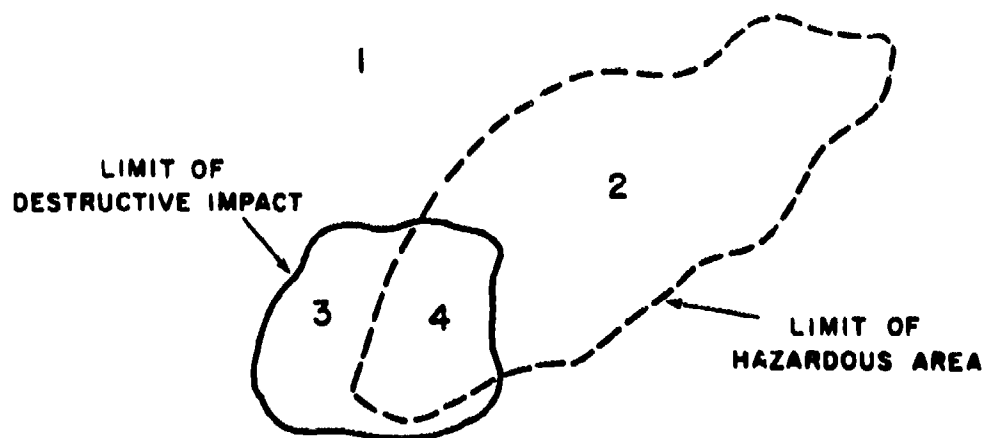
- (1) Free situation
- (2) Paralyzing situation
- (3) Destructive impact situation
- (4) Combined threat situation.

These four situations, which are due to the presence or absence of either class of disaster agent may be visualized as shown in Figure 2. The illustration is based on a hypothetical explosion and fire followed by the release of hazardous materials.

The Free Situation

The free area includes all places that do not receive any significant effects of the disaster agent. In the free area movement would not be restricted nor would protective measures be required, unless a place was threatened by spread of the disaster agent. The free situation also includes the period of forewarning, if any, that precedes impact or onset of a disaster agent.

Forewarning--The onset of many disaster agents is preceded by conditions that make it possible to recognize the increased possibility of the occurrence of the disaster agent and often make it possible to predict the areas that are likely to be affected and in some cases the expected severity and time of onset. Formal systems for notifying communities and the public of environmental conditions that may give rise to hurricanes, tornadoes, thunderstorms, forest fires, and floods have been established in



1. FREE SITUATION
2. PARALYZING SITUATION
3. DESTRUCTIVE IMPACT SITUATION
4. COMBINED THREAT SITUATION

Figure 2 FOUR TYPES OF EMERGENCY SITUATIONS

areas that are likely to experience those situations. The duration of the period of forewarning that is provided by these systems may vary considerably, ranging from a long-range forecast that extreme environmental conditions are likely to warning that impact of the disaster agent is considered imminent.

In the context of this concept of operations, the word forewarning is also applied to the period preceding impact of those disaster agents that are predictable in the sense that their incidence is much more frequent in some areas than in others, even though impact may occur without prior warning. For example, in areas of known seismic activity, while the time and severity of the next earthquake cannot be predicted with any certainty, it can generally be said that the time until the next earthquake becomes less with the passage of each day since the previous earthquake. In like manner, some communities, due to their location, industrial base, or their role as transportation centers, are more likely than others to experience explosions, transportation accidents, and other man caused disasters.

The first contingency situation that should be considered by emergency operations planners may therefore be defined as follows:

Contingency A--Alert. This contingency includes those situations where (1) a community due to its location, terrain features, or other characteristics, is known to be subject to the threat of a potential disaster agent; or (2) where a period of forewarning precedes impact of the disaster agent.

The emergency operations that should be provided for in plans for this contingency include: precautionary actions to prevent the occurrence or limit the effects of the disaster agent (though certain disaster agents cannot be prevented, the severity of their effects may be reduced by precautionary actions); actions to mobilize the resources of the community and increase the readiness of the local government during threatening

situations; and warning the public to start protective actions when the threat of impact is considered imminent.

Postimpact--Following the onset or impact of a disaster agent, communities in the free area should provide support, as needed, to communities in the affected area. As a result, even though a community may not in itself be subject to the threat posed by a given disaster agent--as for example a community that is located on high ground and is not subject to a flood threat--the local government's emergency operations plan should provide for those contingencies where nearby communities may need their support. Interjurisdictional mutual aid agreements are generally a prerequisite to planning such interjurisdictional support.

Since the ability of places in the free area to provide support to other areas would be limited by time and distance factors, it is necessary to subdivide the postimpact free situation into two contingencies:

Contingency B--Distant Impact. This contingency applies if the community is distant from the destructive impact area. Planning for this contingency should call for providing backup support, if needed, in the event of a major disaster.

Contingency C--Close Impact. This contingency applies to those places that are close to the destructive impact area, but are clear of significant damage. Plans for this contingency should provide for close support to communities that have experienced the destructive impact of the disaster agent.

Under each of the above contingencies, which may exist in the free area, the general theme of operations is to provide support to more seriously affected communities, if needed and if feasible, dependent on time and distance relationships. The feasibility of providing such support may be limited, however, in the event that the emergency is caused by a spreading disaster agent. In such an event, a community that is initially in the free area may itself subsequently experience the destructive impact of the disaster agent. In such an event, actions to protect against impact rather than to provide support to other communities would be appropriate.

Destructive Impact Situations

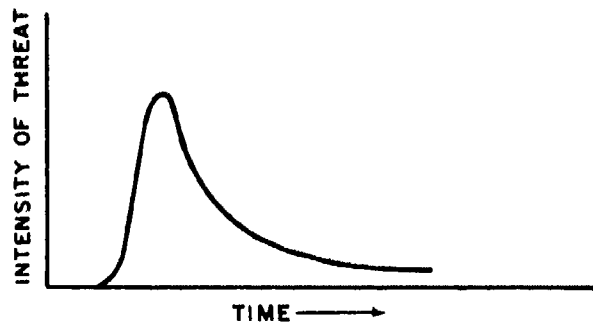
Some disaster agents, such as flash floods, tornadoes, explosions, fires, and the like, have a destructive impact on a community and call for emergency actions such as damage control, fire fighting, search and rescue, first aid, and similar countermeasures to prevent or minimize loss of life and property. As illustrated in Figure 3(a), the speed of onset of these disaster agents is generally rapid, even resembling a pulse, and the time during which effective countermeasure actions can be taken is of short duration. Often, the destructive impact is quite localized. On the other hand, some disaster agents, such as forest fires, may be described as spreading and, over a period of time, may affect large areas. Nevertheless, the impact of these spreading disaster agents is felt in a given place over a relatively short period of time.

Planning for, and conduct of, emergency operations during situations caused by disaster agents with destructive impact hinges on the question of whether or not an area or place can be protected and occupied in the face of the threat posed by the disaster agent. It is therefore necessary to subdivide the destructive impact situation into two contingencies:

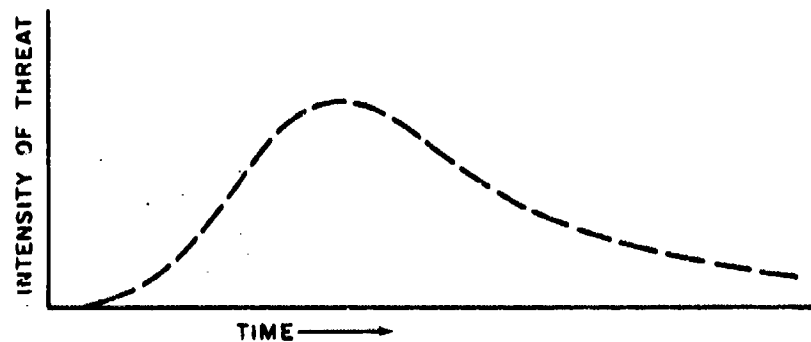
Contingency D--Damaged but Tenable. This contingency includes those situations where a community experiences significant damage from the destructive impact of a disaster agent, and control of the ensuing hazards by in-place countermeasure actions proves to be feasible.

Contingency E--Untenable. This contingency includes those situations where the threat posed by the disaster agent is determined to be uncontrollable, with the result that threatened areas cannot be protected or occupied and must be evacuated in order to prevent loss of life.

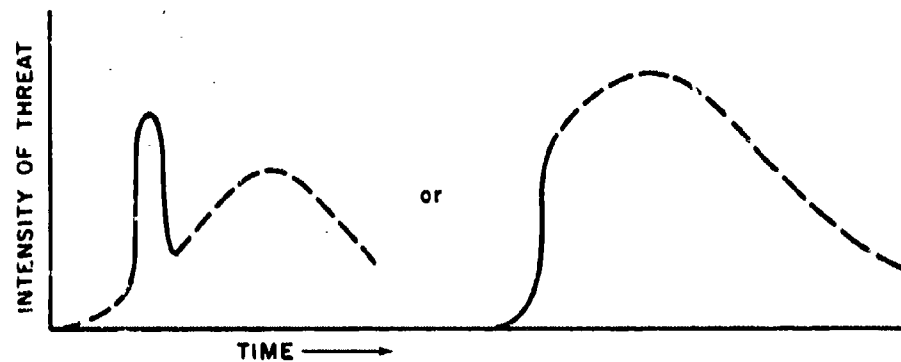
A central element of planning for destructive impact situations should be the identification, during the preemergency period, of areas within a community or geographical area that are particularly susceptible to a



(a) Destructive Impact Disaster Agents



(b) Paralyzing Disaster Agents



(c) Combined Threat Disaster Agents

Figure 3 THREAT DYNAMICS OF DISASTER AGENTS

given threat and that may prove to be untenable in the event of an emergency. At the same time, the plans for these contingencies should identify areas that are either unlikely to be affected by the disaster agent or can be protected and occupied, and are close enough to the potentially untenable areas to be used as relocation sites or reception areas for the evacuees. In the event that safe relocation sites are not located within the community, or in nearby communities, and movement over a long distance would be required to relocate the threatened population in a protected and safe place, the plan should provide for starting the evacuation before the impact of the disaster agent; i.e., during the period of forewarning. Evacuation of low lying coastal areas that are in the path of a hurricane is an example of such a preimpact evacuation.

In the context of this concept of operations, a distinction is made between evacuation that is started before impact of the disaster agent and evacuation that is started after impact. The former is taken in response to a potential threat (under Contingency A) while the latter is taken in response to a real and existing threat that poses an immediate threat to life. Postimpact evacuation may be described as a remedial movement of threatened people to nearby locations that offer greater safety.

A determination of whether or not a particular area may be potentially untenable following impact of a given disaster agent is primarily dependent on the nature of the disaster agent and the characteristics and terrain features of the area. (Uncontrollable fires that call for evacuation of a threatened population before development of an entrapment fire are only possible in areas that have the needed fuel loading; flash floods, whether due to a levee break, a dam break, or torrential rains, can only occur in certain areas.) As a result, by reason of their location, terrain features, building density, or other characteristics, many communities could never experience Contingency E for certain disaster agents.

Paralyzing Situations

The effect of many potential disaster agents may be described as paralyzing rather than destructive. Generally, these disaster agents have a gradual onset and are of a relatively long duration, as shown in Figure 3(b). The intensity of the threat posed by the disaster agent gradually builds up with time, passes through a maximum, and then decreases. Often these disaster agents are spreading, affecting relatively large areas, and are due to environmental conditions.

Winter storms, slow rise floods, and radioactive fallout are perhaps the clearest examples of paralyzing disaster agents. As the intensity of the threat increases (snow and cold, water depths, and radiation intensity), unprotected operations become more difficult and dangerous and have the effect of shutting down or paralyzing the area until the intensity of the threats diminish. Generally, the conditions that give rise to these paralyzing situations are not controllable, and it is necessary to wait until conditions improve due to natural causes rather than to control the situation by countermeasure actions. Therefore, the countermeasure actions that are generally appropriate for this type of disaster agent are to limit or control the exposure of people to the threat, and to keep them in locations that offer protection.

Planning for, and conduct of, operations during emergencies caused by disaster agents with a paralyzing effect hinges on the question of whether or not operations are feasible, outside of protected locations. It is therefore necessary to subdivide the paralyzing situation into two contingencies.

Contingency F1--Moderate Hazards--Operations Feasible. This contingency includes those situations where the threats posed by the disaster agent are substantial, but emergency operations are feasible provided that actions are taken to limit or control exposure of personnel conducting actions outside of protected areas.

Contingency F2--Extreme Hazards--Unprotected Operations Prohibited.

This contingency includes those situations where the intensity of the threat posed by the disaster agent is such that operations outside of protected areas are prohibited. The principal countermeasures for this contingency are to take shelter or other protection from the threat posed by the disaster agent and to suspend all nonessential operations outside the protected areas, until the intensity of the threat diminishes.

Combined Threat Situations

In some emergency situations the destructive impact of a disaster agent may give rise to an ensuing disaster agent that has a paralyzing effect on a community; e.g., an explosion followed by the release of hazard materials. In other cases, a disaster agent may initially present a hazard to unprotected operations and then, as its intensity increases, have a destructive impact on the community; e.g., the wind accompanying a tropical storm limits or prohibits movement outside of protected areas; when the wind approaches hurricane force, it may have a destructive impact on the community. In other situations the two types of disaster agents may be present, but they may not have any causal relationship to one another; e.g., transportation accidents or fires may occur during severe weather conditions though they might not necessarily be caused by those conditions. The emergencies in which a community is threatened by both the destructive impact and the paralyzing type of disaster agents, either concurrently or sequentially, are called combined threat situations.

Since disaster agents that have a destructive impact generally present a more immediate and certain threat to life than do paralyzing disaster agents, the general planning principle for combined threat situations is to give priority to preventing loss of life from threats due to the destructive impact type of agents, while minimizing the exposure to the other hazards that are present, if feasible. When actions to protect against

the threats due to destructive impact disaster agents are completed, it is then appropriate to return to the protective posture that is appropriate to the concurrent hazard.

The dynamics of a combined threat situation may be visualized as indicated by the curves in Figure 3(c). As discussed above, there are five contingencies (A, B, C, D, and E) that are defined by the threat posed by destructive impact disaster agents, and there are two contingencies (F_1 and F_2) that are defined by the threat posed by paralyzing disaster agents. Therefore, a total of ten combined threat situations is possible.

Countermeasure Actions

Table 2 summarizes the countermeasure actions that are appropriate for several types of disaster agents and correlates them to the contingency situations described above. A capital letter in the table indicates the contingency under which the listed countermeasure would be appropriate for a given disaster agent. For example, fire prevention actions are appropriate under Contingency A, while fire control actions are appropriate under D and remedial movement is appropriate under E. An asterisk in the table indicates that the countermeasure action, if necessary, would be directed against the threat posed by concurrent or ensuing disaster agents; e.g., remedial movement may be necessary following an explosion to avoid the threat posed by ensuing fires.

The general content of plans for each type of disaster agent is indicated by Table 2. More importantly, however, the table indicates that for each contingency, regardless of cause, the countermeasure actions are generally the same. This suggests that emergency operations plans can be developed for each contingency, rather than for each disaster agent either separately or in combination. This approach would materially reduce the dimensions of the planning problem.

Table 2

COUNTERMEASURES FOR SEVERAL DISASTER AGENTS

Disaster Agent	Countermeasure Actions									
	Prevention	Preimpact Evacuation	Preimpact Shelter	Control and Suppress	First Aid, Search, and Rescue	Resedial Movement	Limit or Prohibit Operations	Decontamination and Contamination Control	Clear Debris and Structural Hazards	Medical and Refugee Care
Fire	A			D	D, E	E	*	*	D, E	B, C, D
Explosion	*	A	A	*	D, E	*	*	*	D, E	B, C, D
Hurricane winds	*	*	A	*	D, E	*	F	*	D, E	B, C, D
Tornado	*		A	*	D, E	*	*	*	D, E	B, C, D
Thunderstorm	*		*	*	*	*	F	*	*	*
Torrential rain	*	*		*	*	*	F	*	*	*
Winter storm	*			*	F	*	F	*	*	F
Flood	A	A	*	D	D, E	E	F	*	D, E	B, C, D
Earthquake	*			*	D, E	*	*	*	D, E	B, C, D
Tsunami	*	A			D			*	D	B, C
Landslide	A	A			D	E	*	*	D, E	B, C
Transportation accident	*			*	D	*	*	*	D, E	B, C
Release of hazardous materials	A	A		D	*	E	F	F	*	F

Legend: Capital letters, indicating the contingency in which the countermeasure action is appropriate, are explained in Section II of this report.

An asterisk indicates that the countermeasure, if necessary, is directed against the ensuing or concurrent disaster agent(s).

Basic Operating Situations

Based on the above discussion, the spectrum of situations that may occur during an emergency can be reduced to nine BOS (basic operating situations), as shown in Figure 4. The nine BOS encompass all combinations of threats posed by destructive impact and paralyzing disaster agents. They are the central element of this concept of emergency operations and represent an expansion, for planning and operational purposes, of the four emergency situations previously shown in Figure 2.

The basic operating situations are sequentially numbered from 1 through 9. BOS-1 is the situation in which the disaster agent(s), if present, poses a negligible threat. BOS-9 is the most severe situation, in which an area must be evacuated due to the destructive impact of a disaster agent, and, at the same time, there are extreme hazards to operations outside of protected locations.

The BOS number provides a convenient method of summarizing; (1) level of the threat(s) posed by the disaster agent(s) that are present in a given location, and (2) the nature of the countermeasure actions that are appropriate to cope with the threat(s). These threat levels and countermeasure actions are described in general terms in the above discussion of contingency situations. Subsequent paragraphs contain a more detailed discussion of threat levels and countermeasure actions for specific disaster agents.

Dynamics of the Situation

As discussed previously, an emergency can be considered as a dynamic situation during which the threats posed by a disaster agent, or a combination of disaster agents, are changing. The basic operating situations, and more specifically the events that cause a change in the BOS number or

		HAZARD TO UNPROTECTED OPERATIONS		
		NEGLIGIBLE	MODERATE	EXTREME
IMPACT OF DISASTER AGENT	NEGLIGIBLE	1	2	3
	SIGNIFICANT BUT ZONE TENABLE	4	5	6
	RENDERS ZONE UNTENABLE	7	8	9

Figure 4 BASIC OPERATING SITUATIONS

indicate that a change in the BOS number is likely, provide a means for describing the dynamics of an emergency.

Initially, prior to impact or onset of a disaster agent, a location would be in BOS-1. Impact or onset of a disaster agent, if defined as occurring when the first significant effects are observed or reported, would cause a change in the basic operating situation, from BOS-1 to either BOS-2 or BOS-4, dependent on the type of disaster agent. Subsequent changes in the BOS number would be dependent on the severity of the threats posed by the disaster agents, either singly or in combination, and the effectiveness of countermeasure actions to contain or control the ensuing hazards. If the BOS number increases or decreases by 1, it indicates the hazard to unprotected operations has changed. In like manner, if the BOS number changes by 3, it indicates that there has been a change in the situation resulting from the impact of a disaster agent. Eventually, when the threats posed by the disaster agents are no longer substantial, a BOS-1 situation would again prevail. This return to BOS-1 conditions corresponds to the termination of the emergency period as defined above.

The following are examples of events that indicate a potential BOS change may occur: recognition that a place is located in an area that is known to be subject to a disaster agent; receipt of information that threatening environmental conditions are developing; receipt of a warning that impact of a disaster agent is impending or imminent; and, following impact, observation that the ensuing threat(s) that are present have peaked and are decreasing.

Table 3 indicates the BOS changes and potential BOS changes that are possible following the impact or onset of a disaster agent. The possible BOS changes are indicated by two digits separated by a slash. The first digit indicates the initial BOS number and the second digit indicates the subsequent BOS number. Potential BOS changes are indicated by the

Table 3

POSSIBLE CHANGES IN THE BOS

		To BOS:								
		1	2	3	4	5	6	7	8	9
From BOS:	1	(P)	1/2	--	1/4	--	--	--	--	--
	2	2/1	(P)	2/3	--	2/5	--	--	--	--
	3	--	3/2	(P)	--	--	3/6	--	--	--
	4	4/1	--	--	(P)	4/5	--	4/7	--	--
	5	--	5/2	--	5/4	(P)	5/6	--	5/8	--
	6	--	--	6/3	--	6/5	(P)	--	--	6/9
	7	--	--	--	7/4	--	--	(P)	7/8	--
	8	--	--	--	--	8/5	--	8/7	(P)	8/9
	9	--	--	--	--	--	9/6	--	9/8	(P)

Note: The first digit indicates the previous BOS; the second digit indicates the subsequent BOS. (P) indicates a potential BOS change; e.g., fires are brought under control, but not yet out. Dashes indicate a BOS change is excluded by definition.

letter P. Note that certain BOS changes are excluded by definition of the basic operating situations and by the dynamics of the disaster agents. The extreme hazard situation (BOS-3, 6, or 9) would always be preceded by a moderate hazard situation (BOS-2, 5, or 8) even though the duration of the moderate hazard situation might be very short. In like manner, since it is not possible to predict with any degree of certainty the severity of impact, an unterable situation (BOS-7, 8, or 9) would always be preceded by an interval, though perhaps extremely short, that begins

when significant effects of the impact are first observed or reported (BOS-4, 5, or 6) and ends when it is determined that these effects render the zone untenable.

Each change in the basic operating situation, and each event that indicates that a potential change in the basic operating situation is likely to occur, can be considered as an event for which emergency actions can be preplanned.

Threshold Values

For some disaster agents it is possible to assign a numerical value to the threat intensity that corresponds to the threshold of the moderate hazard condition (BOS-2, 5, or 8), and the transition from the moderate to the extreme hazard contingency (BOS-3, 6, or 9). The wind-chill index, the Beaufort wind scale, the radiation intensity, and the concentration of air pollutants are examples of measures that may be used for planning purposes as limits to the moderate and extreme hazard situations. However, what constitutes a substantial hazard to unprotected operations in one community might not be the case in another; for example, some communities often experience and are able to cope with heavy snow conditions, while others cannot. As a result, identification of the onset of a moderately hazardous situation (BOS-2, 5, or 8)--or a worse situation (BOS-3, 6, or 9)--often may require a judgment based on local conditions as well as on the intensity of the threat.

The threshold of the destructive impact situations (BOS-4, 5, or 6) is the first observation or report that a location has experienced the impact of a disaster agent. The transition to the untenable situations (BOS-7, 8, or 9) occurs when and if an operational decision is made that the threatened area cannot be protected or occupied. The factors that must be considered in making this operational decision include: the

intensity of the threat, the capability of the emergency forces to control the threat, and the characteristics of the community--not all places are susceptible to a given threat.

In the event of an emergency in which the community experiences more than one disaster agent having a destructive impact (e.g., an explosion followed by a fire, or an earthquake that gives rise to fires and the collapse of a dam), emergency actions would have to be taken to counter or cope with the concurrent threats caused by the disaster agents in combination. In such concurrent threat situations, the central operational decision that must be made by responsible officials remains whether or not the area can be protected or occupied; that is, whether or not the area is tenable or untenable. If an area is considered to be untenable due to any one of the threats that are present, the appropriate countermeasure would be to relocate the population from the threatened area to safer locations.

It follows, therefore, that the concept of subdividing destructive impact situations according to whether or not an area is tenable or untenable is appropriate to concurrent threat situations as well as single threat situations. A general approach to contingency planning may therefore be derived. This approach may be described as: first in, last out. Emergency operations such as damage control, fire fighting, search and rescue, should be started when the destructive impact of the disaster agent is first observed or reported and must be continued until all threats present, whether due to the initial impact or to the threats posed by ensuing disaster agents, are under control and no longer pose a substantial threat. In the event that any one of the disaster agents that are present in a given situation proves to be uncontrollable and an area cannot be protected or occupied, evacuation of untenable areas will be necessary. Thus, in a concurrent threat situation, the transition from BOS-4, 5,

or 6 to BOS-7, 8, or 9 occurs when it is first recognized that an area will be untenable due to either the initial or an ensuing threat.

In like manner, if more than one paralyzing disaster agent is present during a given situation, the transition from the moderate (BOS-2, 5, or 8) to the extreme hazard contingency (BOS-3, 6, or 9) occurs when it is determined that any disaster agent present poses an extreme hazard to unprotected operations.

Correlation of BOS with Contingency Situations

Contingencies A, B, and C (as defined on pages 14 and 15) include those situations where a location is not affected by the destructive impact of a disaster agent. Under each of those contingencies, however, Contingencies F_1 or F_2 may exist concurrently, and environmental conditions may restrict or prohibit unprotected operations. Therefore the plans for Contingencies A, B, and C should provide for BOS-1, 2, or 3.

Contingency D is the situation where a location is affected by the destructive impact of a disaster agent, but proves to be tenable. Again, hazardous environmental conditions may also be present. The initial conditions following impact are therefore BOS-4, 5, or 6. When the continuing threats are brought under control, BOS-1, 2, or 3 would again prevail. However, the location would still be in Contingency D, since it had been damaged.

Contingency E is the situation where a location is untenable due to uncontrollable threats following impact. Again, there may be concurrent hazards to unprotected operations. Therefore, the initial conditions in Contingency E are BOS-7, 8, or 9. When the threats diminish and reentry to the vacated areas is feasible, Contingency E would remain in effect though BOS-7, 8, or 9 would no longer prevail.

As events unfold during an emergency, the contingency plan that is appropriate to the highest numbered BOS that occurs should be activated and should remain in effect throughout the emergency period even though subsequent events reduce the BOS number.

Controlling Conditions

To provide for those situations where both a destructive impact disaster agent and a paralyzing disaster agent are present at the same time--and where a decision is required as to the priority that should be given to actions to protect against concurrent threats--it is necessary to define the following conditions:

- Condition Black means that an untenable situation (BOS-7, 8, or 9) exists or is imminent.
- Condition Yellow means that moderate hazards (BOS-2, 5, or 8) are present in the community and that extreme hazard conditions are unlikely. Condition Yellow implies that the intensity of the threat is diminishing, or, if it is increasing, it is evident that it will not result in extreme hazard conditions.
- Condition Red means that an extreme hazard situation (BOS-3, 6, or 9) exists or is imminent.
- Condition Orange means that the location has experienced an extreme hazard situation, and that the intensity of the threat has diminished so that moderate hazards (BOS-2, 5, or 8) are currently present.

The above defined color code conditions are used in tables presented later in this report as a basis for establishing the priority of actions that are appropriate to cope with the effects of the disaster agents present in a combined threat situation.

Because the destructive impact disaster agents are considered to present a more certain and immediate threat to life in comparison to the prolonged threat posed by paralyzing disaster agents, in all cases where

an untenable situation exists or is imminent (Condition Black), priority should be given to actions to protect against the threat posed by the destructive impact disaster agent even though there is a concurrent hazard to unprotected operations. For example, in the event that a fire threatens the sheltered population during a hurricane, there is no alternative but to protect against the immediate threat of fire even though fire fighting or remedial movement to another location involves exposure to the extreme hazard due to the wind.

Condition Black may exist concurrently with Conditions Red, Yellow, or Orange. In such concurrent threat situations, Condition Black means that there is no alternative but to initiate countermeasures to protect against the immediate threat to life, even though such actions require exposure to severe or extreme hazards.

Summary of the Concept

Table 4 summarizes the concept of operations for each contingency.

Table 4

SUMMARY OF CONCEPT

<u>Contingency</u>	<u>Highest BOS Numbers</u>	<u>Theme of Emergency Operations</u>
A - Alert	BOS-1, 2, or 3	Increase readiness and protection*
B - Distant impact	BOS-1, 2, or 3	Backup support*
C - Close but clear	BOS-1, 2, or 3	Close support*
D - Damage	BOS-4, 5, or 6	Control damage, fire, and flooding; conduct search, rescue, and first aid*
E - Untenable	BOS-7, 8, or 9	Evacuate untenable areas*
F ₁ - Moderate hazards	BOS-2, 5, or 8	Limit exposure to environmental hazards†
F ₂ - Extreme hazards	BOS-3, 6, or 9	Prohibit nonessential operations†

* Limiting exposure to environmental hazards as feasible if Contingency F exists concurrently.

† Unless an untenable situation exists or is imminent (Condition Black).

III NATURAL DISASTER OPERATIONS PLANS

Organizational Context

The Operating Zone

In this concept, the level of control that is concerned with the conduct of emergency operations is called the operating zone.

It is suggested that the territory of each state be subdivided into operating zones using political subdivision boundaries wherever possible, but also considering terrain features, population distribution, and transportation routes. Most operating zones should be independent political subdivisions; the local governments should be responsible for emergency operations throughout each zone. Some operating zones might consist of a small city and the surrounding unincorporated territory. Others would be districts of large cities or urban counties. Finally, some operating zones might be military bases, large industrial complexes, state or federal institutions, or other installations having their own police and fire services.

To the extent feasible, operating zone boundaries should be compatible with the manner in which local governments are organized and normally operate within an area. However, the normal organization and operating procedures should not dictate either the zonal boundaries or the emergency organization within a zone. In urbanized areas that typically include a number of independent city, county, and special purpose district governments, the normal service areas and jurisdictional boundaries of the several local governments often overlap one another. In such areas, the normal methods of operating may not work during an emergency, and jurisdictional considerations may impede emergency operations. Arrangements

should be made during the preemergency period to overcome such jurisdictional constraints and to coordinate emergency operations.

Each operating zone should contain sufficient resources to make independent operations feasible and preferably should be small enough so that it would experience only one, or at most a few, BOS at any one time during an emergency. These two criteria act in opposition to one another. Generally the larger the city, the greater is its capability in terms of police, fire, public works, medical, and other resources. At the same time, however, the jurisdictional area generally increases with population size, and during an emergency the severity of the threats posed by a disaster agent (the BOS) may vary considerably from one part of the city to another. Subdivision of large jurisdictions into operating zones is therefore recommended for purposes of reporting and assessing the situation in various parts of the jurisdiction and for decentralizing control of emergency operations. This does not preclude central dispatch of police, fire, and other emergency forces, but provides the means of decentralizing control if it proves necessary.

An EOC (emergency operating center) should be designated in each operating zone. The EOC should be located outside of potentially untenable areas of the zone. It should be located in a facility that affords substantial protection and it should be equipped with the communications needed for direction and control of emergency operations.

Mutual Aid Areas

Emergency operations plans should delineate areas that might be called Mutual Aid Areas. Such an area would consist of a number of operating zones, close enough to one another to permit interzonal mutual aid operations during an emergency period.⁶

Information regarding the BOS in each operating zone and the need for and availability of support is considered to be the central requirement for coordinating mutual aid and other interzone operations. Therefore, a coordination center should be established in each Mutual Aid Area, and it should be provided with communications to the headquarters of each included operating zone. During an emergency, the coordination center would act as a clearinghouse for information regarding the situation throughout the area, for coordinating interzonal movements, for coordinating mutual aid, and for obtaining support from state and federal agencies and from nongovernmental organizations within the area.

A Mutual Aid Area might consist of a single county or a group of contiguous counties. In some cases, Mutual Aid Areas might include portions of more than one state. Again, when setting up the boundaries of Mutual Aid Areas, normal jurisdictional boundaries should be considered, but they should not dictate the choice. In large Mutual Aid Areas, intermediate headquarters between operating zones and the Mutual Aid Area headquarters might be needed to reduce the span of communications. In like manner, several Mutual Aid Areas might be grouped to form a Mutual Aid Region with a regional coordination center.

Concept of Operations

Normal Conditions

Under normal conditions, an EOP (emergency operations plan) will be maintained. It should be a set of standby contingency plans to be activated in the event of a possible emergency. The local government will participate with the federal, state, and other local governments in the nationwide civil defense preparedness program. As additional capabilities that would contribute to the preservation of life and property are identified, or as new capabilities are developed, plans for their use

during an emergency will be incorporated into the EOP. The EOC (emergency operating center), a warning and communication system, and other elements of a system for direction and control of emergency operations will be maintained in a standby readiness condition. Key personnel from each of the emergency operating services will participate in periodic exercises and training programs.

In an area that is known to be subject to a given disaster agent, precautionary measures will be taken to limit the effect of that agent and, if feasible, to prevent its occurrence. In addition, those areas that are susceptible to a given threat and that may prove to be untenable following the impact of a disaster agent will be identified as high-risk areas. For each high-risk area that is identified, a nearby low-risk area will be designated as a relocation site.

At least one MSA (multipurpose staging area) should be selected in each operating zone.⁷ The MSA is a predesignated location for deploying personnel and equipment of the emergency forces, a destination point for mutual aid units coming into a zone, and a base for conducting disaster recovery operations.

Contingency A--Alert

In the event that reports indicate that a threatening situation exists or may develop, the EOP will be activated and actions will be taken to improve the capability and increase the readiness of the local government to carry out its responsibilities for protection of life and property. Priority will be given to protection against the destructive impact of a disaster agent while, at the same time, actions will be taken to minimize or avoid exposure of personnel to concurrent hazards, should they be present. The emergency actions to be considered under Contingency A represent a graduated response to a developing threat and will be undertaken by

decision of the local authorities as events unfold during the developing emergency. Initially, actions will be limited to reviewing plans, accelerating on-going preparedness programs and providing emergency information and advice to the public. Precautionary actions such as mobilizing resources, activating the EOC, and deploying personnel and equipment to assigned duty stations will start if the situation poses an impending threat. If a warning that the impact of a disaster agent is imminent is received, public warning signals will be sounded and the public will be directed to take shelter or to take other protective actions appropriate to the threat. The events included in the plan for Contingency A and a summary of the preplanned actions for each event are listed in Table 5.

If, while in Contingency A, environmental conditions present a substantial hazard to unprotected operations, nonessential operations will be restricted or prohibited as described for Contingency F below.

Contingency B--Distant Impact

In the event that the impact of a disaster agent is reported, a local government that is distant from the impact area will activate Contingency Plan B. If the impact was caused by, or results in, a spreading type of disaster agent and the local government's zone is in its path, protective actions will be started. The public will be warned, if this has not already been accomplished in Contingency A, above. If the local zone is not threatened, backup support will be provided to more seriously affected areas, if requested and needed. If while in Contingency B, environmental conditions present a substantial hazard to operations, nonessential operations will be restricted or prohibited as described in Contingency F, below. The events included in the plan for Contingency B and a summary of the preplanned actions for each event are listed in Table 6.

Table 5

SYNOPSIS OF PLAN FOR CONTINGENCY A
(Alert)

<u>Events Considered in Plan A</u>	<u>Summary of Response to Event</u>
Zone is known to be in an area subject to disaster agent.	Consult with higher headquarters and the local disaster council as to advisability of IR (increased readiness) actions. Review and update EOP and other operating plans.
Reports indicate a potentially threatening situation exists or may develop.	Accelerate normal preparedness programs. Review plans and guidance, service annexes and mutual aid plans. Bring EOC to readiness and establish duty watch. Activate reporting system.
Advised that situation poses an impending threat to zone.	Man EOC around the clock. Initiate programs to reduce vulnerability and provide added protection to people and facilities. Improve readiness of all services.
Decision to deploy forces in anticipation of warning.	Deploy emergency forces and equipment to preplanned duty stations, fully manning all control centers. Start shut-down, ready shelters for occupancy, continue IR activities from deployed posture.
Warning is received. Impact of disaster agent is imminent (control symbol: Black)	Disseminate warning, complete deployment, secure and back up communications, expedite and control move to safety, shut down non-essential services, evacuate untenable areas.
Advised that threat posed by situation has diminished or ended.	Take action to decrease levels of readiness as determined by disaster council.
Impact of disaster agent is observed or reported.	In distant zone, activate Plan B; close to or within zone, activate Plan C.

Table 6

SYNOPSIS OF PLAN FOR CONTINGENCY B
(Distant Impact)

<u>Events Considered in Plan B</u>	<u>Summary of Response to Event</u>
Impact of disaster agent on distant zone is observed or reported.	Advise higher headquarters of observations or reports, advise and alert services and observation stations, inform public of situation, maintain essential services.
Advised that disaster agent does not pose a threat to local zone.	Inform public of situation, reestablish normal operations, prepare to care for refugees, provide backup support for seriously affected zones and areas if requested.
Advised that zone is in the path of disaster agent (control symbol: Black)	Warn public, activate EOC and subordinate headquarters, protect and back up communications, complete deployment of emergency equipment and personnel, maintain essential utilities, shut down nonessential services, evacuate untenable areas.
Advised that threat has diminished or ended.	Consult with disaster council and take action necessary to return to appropriate level of readiness.
Impact of disaster agent is observed or reported in vicinity.	Activate Plan C.

Contingency C--Close to Impact

In the event that the destructive impact of a disaster agent is observed or reported, those operating zones that are in the vicinity will activate contingency Plan C and will immediately survey their jurisdiction to determine whether or not they have experienced significant effects. If significant effects (structural damage, fires, and dangerous flooding, and so forth) are reported in any zone of the jurisdiction, Contingency Plan D will be activated immediately.

If the jurisdiction is found to be clear of effects, Contingency Plan C will remain in effect. Close support will be provided to nearby more seriously affected jurisdictions, as needed, unless prohibited by concurrent hazards or by the threat posed by a spreading disaster agent. Close support may include dispatching emergency forces to assist operations in more seriously affected areas and receiving, caring for, and sheltering evacuees. If, while in Contingency C, environmental conditions present a substantial threat to operations, nonessential operations will be restricted or prohibited as described for Contingency F, below. The events included in the plan for Contingency C and a summary of the pre-planned actions for each event are presented in Table 7.

Contingency D--Damage

In the event that any zone of a jurisdiction experiences the destructive impact of a disaster agent, Contingency Plan D will be activated immediately. All available local forces will be employed, as needed, to control damage, to fight fires, to conduct search and rescue, to provide first aid, and to assist survivors to safe locations where they may be cared for. These emergency actions to protect against immediate threats to life will be taken whether or not concurrent hazards are present. If needed, support will be requested from nearby jurisdictions that are in Contingency C.

Table 7

SYNOPSIS OF PLAN FOR CONTINGENCY C
(Close to Impact)

<u>Events Considered in Plan C</u>	<u>Summary of Response to Event</u>
Impact of disaster agent in vicinity--effects uncertain (control symbol: Black)	Poll subordinate headquarters and deploy mobile units to determine situations. Suspend controls to secondary hazards until survey is complete.
Serious structural damage, developing fires or dangerous flooding in zone (control symbol: Black)	Activate Plan D.
Survey indicates zone is not affected.	Report to higher authority, inform public and maintain people in safe areas, provide support for operations in and evacuation of seriously affected zones, prepare to receive and care for refugees.
Spread of disaster agent from neighboring zone.	Activate Plan D.
Advised that no further impacts are likely.	Establish emergency welfare centers to provide for needs of people in zone or evacuees from other zones, provide support to more seriously affected zones. Reestablish essential services as feasible, and establish controls over surviving resources.
Warning of additional impacts is received.	Disseminate warning, advise public and emergency forces to return to best protective posture.

In the event that the disaster agent proves too uncontrollable and threatened areas cannot be protected or occupied, Contingency Plan E will be activated immediately. Otherwise Contingency Plan D will remain in effect throughout the emergency period. If, while in Contingency D, there are concurrent hazards that present a substantial threat to operations, nonessential operations will be restricted or prohibited as described for Contingency F, below. The events included in the plan for Contingency D and a summary of the response to each event are presented in Table 8.

Contingency E--Evacuation of Untenable Areas

In the event that the destructive impact of a disaster agent results in an uncontrollable continuing threat to life and it is determined that threatened areas cannot be protected or occupied, Contingency Plan E will be activated immediately. Areas that are subject to the threat posed by the disaster agent(s) will be evacuated immediately and the threatened population moved to predesignated locations that afford greater safety. All available forces will be employed to assist in the relocation of people; to perform search, rescue, and first aid as feasible; and to care for evacuees. Damage control efforts will be centered on protecting people enroute and preventing the spread of the disaster agent, if feasible. After the remedial movement of the threatened population has been completed, operations outside of protected areas will be restricted or prohibited, in accordance with Contingency Plan F, if concurrent hazards are present. The events that are included in Contingency Plan E and a summary of the response to each event are presented in Table 9.

Table 8

SYNOPSIS OF PLAN FOR CONTINGENCY D
(Damage)

<u>Events Considered in Plan D</u>	<u>Summary of Response to Event</u>
Impact of disaster agent--serious structural damage, developing fires, or dangerous flooding (control symbol: Black).	Determine damage and status of service units, inform public of situation, broadcast emergency instructions, fight and prevent spread of fires, perform rescue and provide first aid and medical care, call for assistance in accordance with mutual aid plan, execute remedial movement plan for untenable areas, establish refugee centers in safe areas.
Areas are determined to be untenable (control symbol: Black).	Activate Plan E.
Advised that fires are under control or flooding no longer dangerous. All areas of zone are tenable.	Continue search, rescue, first aid, and medical care; provide assistance to nearby more seriously affected zones; receive, shelter, and care for refugees; establish access control to affected areas; restore essential services; demolish hazardous structures.
Advised that fires and flooding are negligible throughout zone.	Instruct public to remain in safe areas; continue search, rescue, and medical care; provide assistance to nearby more seriously affected zones; restore utilities; control access to affected areas.
Advised that further impact is unlikely.	Maintain public in safe areas, direct them to emergency welfare centers as necessary, arrange transportation for refugees, establish resource controls and priorities for restoration of essential industry and community services.
Impact warning is received.	Disseminate warning. Return public to best protective posture. Suspend service operations except those essential to protect population.

Table 9

SYNOPSIS OF PLAN FOR CONTINGENCY E
(Evacuation of Untenable Areas)

Events Considered in Plan E	Summary of Response to Event
Advised that areas of zone are untenable (control symbol: Black).	Order evacuation of areas, search areas evacuated and perform rescue and first aid. Provide shelter and medical care at relocation sites. Concentrate protective efforts against hazards at relocation sites and on people en route. Consider movement of unsheltered and injured to emergency welfare and medical centers in nearby zones. Suspend control of exposure to secondary hazards until evacuation is complete.
Advised that fires are under control or flooding is no longer dangerous in evacuated areas; remainder of zone is tenable.	Maintain protective posture. Continue to maintain hazard control lines. When feasible search evacuated areas, rescue, and care for survivors. Relieve imbalances in loading between shelters and evacuation sites.
Critical period of time elapses without additional impact.	Maintain population in safe areas; establish feeding and sleeping arrangements in shelters.
Advised that residual hazards present negligible threat.	Advise people to remain in relocation sites and shelters until informed that danger is over. Release emergency units to return to shelter posture.
Advised that further impact is unlikely.	Depending on damage suffered by zone, establish MSAs to provide transportation to other zones. Set up emergency welfare centers in zone to care for people released from shelters or returning from relocation areas. Provide essential utilities and services. Establish resource controls and priorities for restoration of essential industry and community services.
Impact warning is received.	Advise people to return to best protective location. Suspend operations of all services except those essential for protection of population.

Contingency F--Hazardous Environmental Conditions*

In the event that environmental conditions present a hazard to operations outside of protected locations during any of the contingency situations described above, exposure controls will be imposed on the emergency operations in accordance with the following plans. A disaster watch will be established, and the public will be informed when it is first recognized that potentially hazardous conditions are developing. The action necessary will depend on the situation:

- If it is observed or reported that environmental conditions present a substantial hazard to operations outside of protected areas, the public will be advised to delay or suspend nonessential activities that require exposure to environmental conditions, and the exposure of personnel conducting needed emergency operations will be limited (Condition Yellow).
- If an extreme hazard situation is reported or is considered imminent (Condition Red), all nonessential operations will be suspended and the public will be advised to remain in protected locations until the hazards diminish. When outside operations are again feasible (Condition Orange), recovery operations will start. People will be advised to remain in protected locations, and the exposure of personnel conducting recovery operations will be limited as long as substantial hazards are present.
- If an untenable situation exists or is imminent (Condition Black) due to a disaster agent with destructive impact, the above described exposure controls will be suspended until actions are completed to protect against immediate threats to life.

The events that are included in Contingency Plan F and a summary of the response to each event are presented in Table 10.

* The term environmental conditions includes pollutants and hazardous materials as well as natural phenomena such as wind, water, heat, or cold.

Table 10

SYNOPSIS OF PLAN FOR CONTINGENCY F
(Exposure Control Plan)

Events Considered in Plan F	Control Symbol	Summary of Response to Event
Negligible hazards Zone is located in area subject to floods, severe weather, or other potentially hazardous environmental conditions.		Maintain procedures for obtaining weather and river forecasts.
Advised that hazardous conditions are likely.		Activate local observing stations, keep public and services advised, take precautionary actions appropriate to threat.
Advised that hazardous conditions are no longer likely.		Advise public and services to discontinue precautionary actions.
Onset of moderately hazardous conditions reported--intensity increasing		Activate Moderate Hazards Plan.
Moderate hazards--F₁ Onset of hazardous conditions reported--intensity increasing.	Yellow	Control exposure of personnel conducting essential operations, delay nonessential operations, determine whether extreme hazards are likely.
Reports indicate extreme hazard situation is likely.	Red	Suspend nonessential operations outside of protected areas, monitor and control exposure of personnel conducting essential operations, advise public to seek shelter or other protection appropriate to threat.
All hazards present have peaked and are decreasing.	Yellow	Maintain exposure controls until all hazards are negligible.
All hazards have decreased below moderate hazard threshold.		Suspend exposure controls; continue monitoring the situation until it is certain that hazardous conditions will not recur.
Onset of extremely hazardous conditions reported.	Red	Activate Extreme Hazards Plan.
Extreme hazards--F₂ Onset of extremely hazardous conditions reported--intensity increasing.	Red	Unless Condition Black prevails, suspend operations outside of protected locations.
All hazards have peaked and are decreasing.	Red	Unless Condition Black prevails, maintain protective posture.
All hazards have decreased below extreme hazard threshold.	Orange	Authorize exposure-controlled operations to sustain sheltered population, initiate recovery actions.
All hazards present have decreased below moderate hazard threshold.		Suspend exposure controls. Continue recovery operations as needed. Continue monitoring the situation until certain that hazardous conditions will not recur.

Checklist for Natural Disaster Operations Planning

A master checklist of emergency actions for each of the above described contingencies has been submitted to OCD separately from this report. The checklist utilizes the split page format and the control symbols that were previously developed for nuclear emergency operations plans.³ In the checklist, the response to each event--as shown in the preceding tables--is specified in terms of actions assigned to the police, fire, medical, shelter, and resources services, and to elements of the direction and control organization.

An alternate format for the checklist is described in the report on nuclear emergency operations planning at the area level.⁶

GLOSSARY

BOS	basic operating situation
EOC	emergency operating center
EOP	emergency operations plan
IR	increased readiness
MSA	multipurpose staging area
NADOP	natural disaster operations plan
NEOP	nuclear emergency operations plan

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Appendix

**NATURAL DISASTERS THAT WERE REVIEWED DURING THE COURSE
OF THIS STUDY**

Appendix

NATURAL DISASTERS THAT WERE REVIEWED DURING THE COURSE OF THIS STUDY

Levee break	- Yuba City, Sutter County California, December 1955
Dam break	- Baldwin Hills, California, December 1963
Slow rise flood	- Norfolk, Madison County, Nebraska, February, March 1971
	- Southwest Minnesota, March, April 1965
Industrial fire	- Bondsville, Massachusetts, October 1968*
	- Webster, Massachusetts, January 1969*
Forest fire	- San Diego County, California, September, October 1970
Earthquake	- Anchorage, Alaska, March 1964
	- Los Angeles, California, February 1971
Tsunami	- Crescent City, California, March 1964
Explosion	- Indianapolis Coliseum, October 1963
Tornado	- Southern Mississippi, February 1971
	Greenwood/Leflore County (damage)*
	Jackson/Hinds County (support)*
Hurricane	- Mississippi, August 1969 (Hurricane Camille)
	Biloxi (extreme damage)*
	Harrison County (severe damage)*
	Bay St. Louis/Hancock County (heavy damage)*
	Pascagoula City (some damage, and also support)*
	Jackson/Hinds County (support)*

Transportation
accident

- Claremont, Massachusetts, March 1966 (train
derailment--chlorine gas)†
- Claremont, Massachusetts, September 1968 (train
derailment--hydrocyanic acid)†

* Asterisk indicates that a disaster scenario was derived. These scenarios have been submitted to OCD under separate cover.

† Possible release of hazardous chemicals did not materialize.